



REMR TECHNICAL NOTE EM-CR-1.1

SELECTION GUIDE FOR WROUGHT STAINLESS STEEL FASTENERS FOR CIVIL WORKS APPLICATIONS

PURPOSE: To provide information on a selection guide for stainless steel fasteners.

BACKGROUND: Civil works projects such as pumping stations and turbine generators can cost millions of dollars to build and maintain. An almost insignificant part of this expense is for high-strength bolts used to anchor pumps and turbines and to join pump flanges. However, some of the bolts now used in civil works systems have failed in less than the designed life. Such failures can cause downtime and significantly increase operation and maintenance costs. In many cases, the cost of the material for the failed part is negligible compared to the repair cost and consequent losses in navigation and hydroelectric power production.

DESCRIPTION: A selection guide for stainless steel (SS) fasteners is available from the Construction Engineering Research Laboratory. When selecting stainless steels for testing as part of development of the guide, the following characteristics were considered:

- a. Low uniform corrosion rate.
- b. Resistance to pitting and crevice corrosion.
- c. Electrochemical compatibility with other metals in the structure.
- d. Resistance to concentration cell corrosion.
- e. Resistance to stress corrosion cracking and corrosion fatigue.
- f. Resistance to erosion and corrosion cavitation.
- g. High strength and toughness.
- h. Mechanical compatibility with other metals in the structure.

Using these properties as guidelines, eight grades of stainless steel were selected for testing:

- a. 304.
- b. 410.
- c. Carpenter steel custom 450.

- d. Carpenter steel custom 455.
- e. ARMCO 17-4 PH.
- f. ARMCO PH 13-8 MO.
- g. Nitronic 50(N50).
- h. Nitronic 60(N60).

RECOMMENDATIONS: Based on a review of literature and the results of corrosion tests, including potentiodynamic, galvanic, cavitation, and galling tests, the following guidance is offered:

- a. The 410 should not be used for high-strength fasteners in aqueous environments, but may be used for applications such as plates where low stresses and mildly corrosive environments are encountered.
- b. The 304 is recommended for use as a corrosion-resistant material where low stresses are encountered, such as gate seal plates.
- c. The Nitronic 50 is recommended for low-strength applications where resistance to pitting attack by chlorides is desired.
- d. The Nitronic 60 exhibits good corrosion resistance and is suggested for use as an antigalling material at relatively low to moderate stresses. Other steels having corrosion resistance similar to 304 should be used where higher strengths are necessary.
- e. The ARMCO 17-4 PH and Carpenter Steel custom 450 are recommended for use in aqueous environments such as bolts in pumps and turbines where high strength and corrosion resistance are required. Heat treatment should be specified.
- f. The ARMCO PH 13-8 MO and Carpenter Steel custom 455 are recommended for use in air for high-strength applications such as piston rods. These steels have very high strengths; consequently, they are susceptible to stress corrosion cracking and are recommended for use only in air.

After a thorough investigation into the mechanical properties, corrosion resistance, and cost of the eight wrought stainless steels, it was concluded that no single stainless steel can offer optimum performance under all conditions and that selection of the steel must consider all these factors.

REFERENCES: a. Wrought stainless steel fasteners for civil works applications. E. G. Segal, et al. US Army Construction Engineering Research Laboratory, Champaign, IL, Mar 1982. Technical Report TR M-306.